SECTION I (50 marks)

*Answer **all** the questions in this section in the spaces provided.*

1 Round off each of the numbers in the expression $\dfrac{4.957}{0.2628-0.0149}$ to 3 significant figures, hence evaluate the expression. (2 marks)

2 Given the matrices $\mathbf{A} = \begin{pmatrix} 2 & 4 \\ 3 & 0 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 2 & 3 \\ 1 & 1 \end{pmatrix}$, find $\mathbf{AB} - 5\mathbf{B}$. (3 marks)

3 Three types of coffee, A, B and C are mixed such that A:B = 4:3 and B:C = 1:2. Determine the mass of type C in a mixture of 52 kg. (3 marks)

4 In a Geometric Progression (G.P), the 4th term is 24, and the 6th term is 96. Determine:

(a) the common ratio of the G.P; (2 marks)

(b) the first term of the G.P. (2 marks)

5 Two fair dice are rolled together and the sum of the numbers showing on the top faces noted.

(a) Represent all the possible outcomes in a probability space. (2 marks)

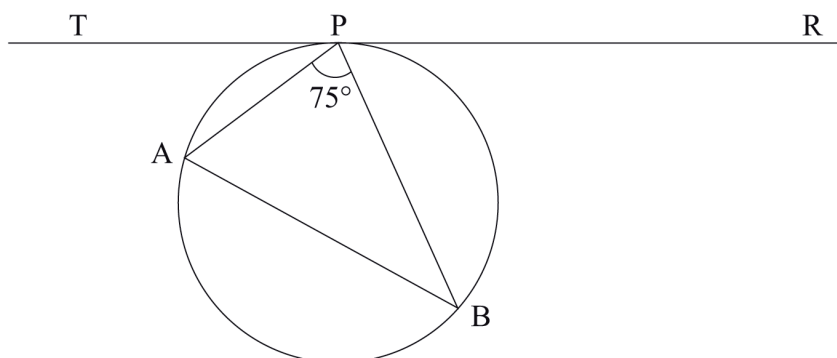(b) Determine the probability that the sum is greater than 6 but less than 10. (1 mark)

6 Two points A and B are such that $\mathbf{OA} = \begin{pmatrix} 2 \\ 5 \end{pmatrix}$ and $\mathbf{AB} = \begin{pmatrix} 4 \\ 4 \end{pmatrix}$. M is a point on $\mathbf{AB}$ such that $\mathbf{AM} : \mathbf{MB} = 3:1$.

Determine:

(a) $\mathbf{OB}$; (2 marks)

(b) the coordinates of M. (2 marks)

41

7 In the figure below, TPR is a tangent to the circle at P. Angle APB $= 75°$ and angle BPR is twice angle APT.


Determine the size of angle BAP. (2 marks)

8 Given that $2\cos(x - 30)° = -0.9$, determine the value of x for $0° \leq x \leq 180°$ correct to 2 decimal places. (3 marks)

9 The vertices of a triangle RST are R(1, 3), S(1, 7) and T(-1, 4). Triangle RST is mapped onto triangle R′S′T′ by transformation matrices $\mathbf{P} = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ followed by $\mathbf{Q} = \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$.

Find the coordinates of R′S′T′. (3 marks)

10 Using the method of completing the square, solve the equation $2x^2 + 8x = 15$, correct to one decimal place. (3 marks)

11 (a) Using a ruler and a pair of compasses only, construct an inscribed circle in triangle ABC given below. (2 marks)
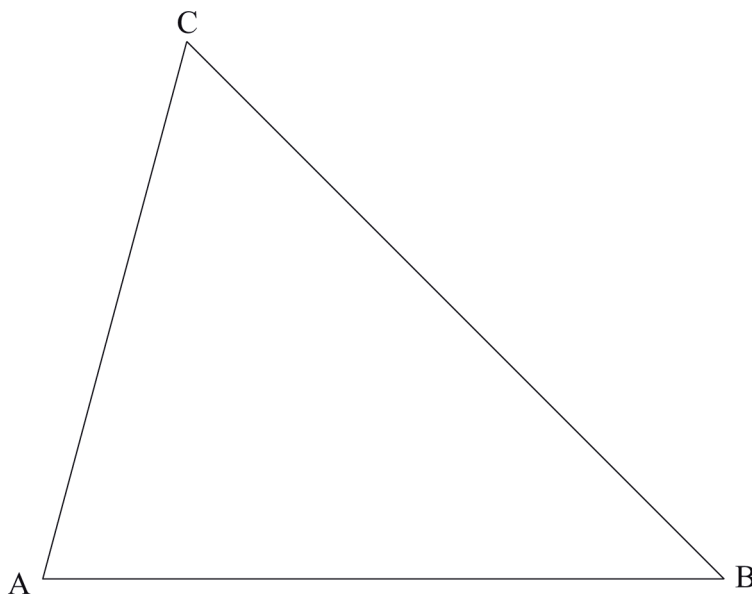
(b) Measure the radius of the circle. (1 mark)

12 In a camp, there was enough food to feed 2000 people on equal rations for 90 days. After 20 days 500 more people joined the camp. Calculate the number of days that the remaining food would be used to feed the people. (4 marks)

13 Figure PQRS below represents a garden in which,
PQ = 80 m, PS = 75 m, SQ = 40 m, ∠SQR = 68° and ∠SPQ = ∠SRQ.
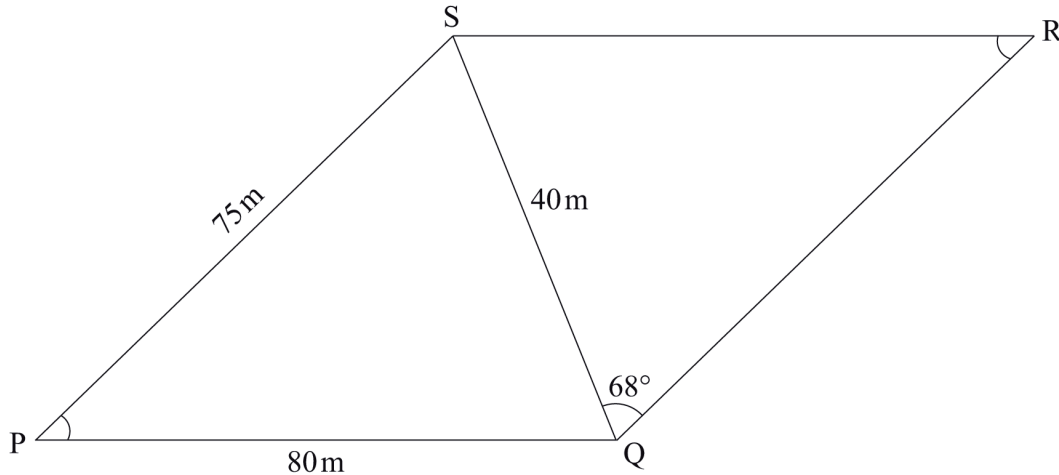
Calculate, to 2 significant figures, the length of SR. (3 marks)

14 The table below shows part of income tax rates in a certain year.

Monthly Income in Ksh	Tax Rate in each Shilling
Up to 10 164	10%
From 10 165 to 19 740	15%
From 19 741 to 29 316	20%

In a certain month of that year, Abdala's income was Ksh 21 820. He was entitled to a monthly personal tax relief of Ksh 1162. Calculate the income tax paid by Abdala that month. (4 marks)

15 Ali and Kinjo bought the same type of pencils and rubbers from the same shop. Ali bought 2 pencils and 3 rubbers for Ksh 66, Kinjo bought 7 pencils and 2 rubbers for Ksh 129. Find the cost of a pencil. (3 marks)

16 The table below shows marks scored by students in a mathematics test.

Marks	20 − 29	30 − 39	40 − 49	50 − 59	60 − 69	70 − 79	80 − 89	90 − 99
Number of students	4	6	8	10	9	7	4	2

On the grid provided below, draw an ogive to represent the data. (3 marks)

SECTION II (50 marks)

*Answer only **five** questions from this section in the spaces provided.*

17 Kurao borrowed Ksh 300 000 from a financial institution. The institution charged compound interest at the rate of 18% per annum on the outstanding balance at the end of each year. At the end of the first and second years, he made equal repayments of Ksh 134 000. He repaid the remaining amount of money plus interest at the end of the third year.
Calculate:

    (a)   the interest charged at the end of the first year;   (2 marks)

    (b)   the principal at the beginning of:

        (i)   the second year;   (2 marks)

        (ii)   the third year.   (2 marks)

    (c)   the amount of money Kurao paid at the end of the third year.   (2 marks)

    (d)   the total interest charged on the loan.   (2 marks)

18   (a)   The nth term of a sequence is given by $U_n = n^2 - n + 3$

        Determine:

        (i)   the 10th term of the sequence;   (2 marks)

        (ii)   the difference between the 30th and the 20th terms of the sequence;   (2 marks)

        (iii)   the value of n given that $U_n = 243$.   (3 marks)

    (b)   In a research, it was found that the number of bacteria tripled every hour. Given that the number of bacteria at the start of a certain hour was 180:

        (i)   write an expression for the number of bacteria after *t* hours;   (1 mark)

        (ii)   determine the number of bacteria, to the nearest million, after 12 hours.   (2 marks)

19 The time in minutes each student in a group took to solve a certain mathematics question is shown in the table below.

Time in Minutes	0 – 1	1 – 2	2 – 3	3 – 4	4 – 5	5 – 6	6 – 7	7 – 8
Number of students	2	4	3	5	8	6	5	3

    (a)   State the modal class.   (1 mark)

    (b)   The above data was represented in a pie-chart, determine the angle that represented the number of students who answered the question in 4 – 5 minutes.   (2 marks)

(c)   Calculate the mean time taken to solve the question.   (4 marks)

(d)   On the grid provided, draw a bar graph to represent the data.   (3 marks)

20   A curve is represented by the equation $y = -2x^2 + 7x - 3$.

(a)   Make a table of the values of x for: $-1 \leq x \leq 4$ and the corresponding values of y for the curve.   (2 marks)

(b)   On the grid provided, draw the graph of $y = -2x^2 + 7x - 3$ for $-1 \leq x \leq 4$.   (3 marks)

(c)   Use the graph to determine:

      (i)   the roots of the equation $-2x^2 + 7x - 3 = 0$;   (2 marks)

      (ii)   the instantaneous rate of change of the curve at $x = 1$.   (3 marks)

21   Four vectors are such that **OA** $= -2i + j$, **OB** $= 3i + 5j$, **OC** $= -8i - 12j$ and **OD** $= 2i - 4j$.

(a)   Express in terms of i and j, the vectors:

      (i)   **AB**;   (2 marks)

      (ii)   **CD**.   (2 marks)

(b)   Determine the co-ordinates of the mid-point of **AD**.   (3 marks)

(c)   Calculate to 3 significant figures, the magnitude of **BC**.   (3 marks)

22   Two points P and Q lie on the equator. The position of P is (0°, 12° E) and that of Q is (0°, 60° W).
State the radius of the earth to be 6370 km and $\pi = \frac{22}{7}$).

(Take the radius of the earth to be 6370 km and $\pi = \frac{22}{7}$).

(a)   (i)   Calculate the distance from P to Q in kilometres.   (3 marks)

      (ii)   Determine the local time at Q when the time is 9.00 pm at P.   (3 marks)

(b)   A point T is due North of Q. An aeroplane flying from Q at 1001 km/h takes 2 h to reach T. Determine the position of T.   (4 marks)

23   A relation connecting three variables R, C and T is such that R varies directly as the square of C and inversely as T. When R = 30, C = 6 and T = 2.4.

(a)   Find:

      (i)   the constant of proportionality;   (3 marks)

      (ii)   the equation connecting R, C and T.   (1 mark)

(b)   Given that R = 40 and C = 8, determine:

   (i)   the value of T;   (2 marks)

   (ii)   the percentage change in R when C decreases by 10% and T increases by 8%.
                                                                                           (4 marks)

24   In the figure below the area bounded by the curve, the *y*-axis, the *x*-axis and the line *x* = 5 represents a map of a piece of land.
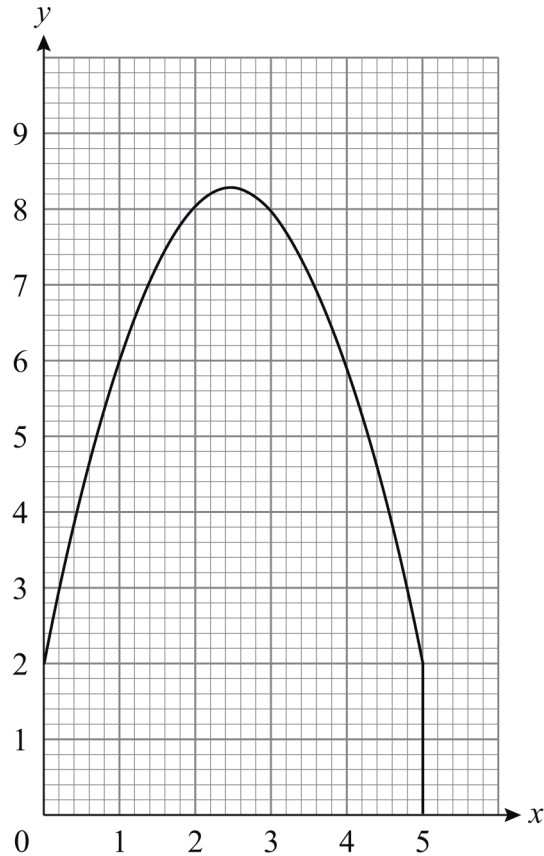
(a)   Estimate the area of the map in cm² by:

   (i)   the counting technique;   (2 marks)

   (ii)   using the trapezium rule with 5 strips of equal width.   (3 marks)

(b)   Given that the actual area of the map is $30\frac{5}{6}$ cm², calculate:

   (i)   the percentage error, correct to 2 significant figures, when the trapezium rule is used to estimate the area of the map;   (2 marks)

   (ii)   the actual area in hectares of the piece of land if the scale used was 1:12000.
                                                                                           (3 marks)